

THE AEROSPACE CORPORATION



*Post Office Box 95085, Los Angeles, California 90045, Telephone 648-5000*

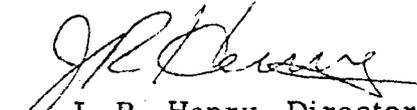
69-2710-JRH-35  
30 June 1969

Subject: Aerospace Corporation Technical Evaluation of  
the GE Contract

To: MOL Systems Program Office  
(Colonel C. L. Gandy, Jr., SAFSL-14)  
Air Force Unit Post Office  
Los Angeles, California 90045

Forwarded to you separately are six (6) copies of  
a report containing the Aerospace Corporation evaluation of the  
General Electric Company's effort on the MOL Program.

THE AEROSPACE CORPORATION

  
J. R. Henry, Director  
GE Segment Office  
MOL Division

~~SECRET/DORIAN~~

BIF-107-50250-69

Copy 7 of 7  
Page 1

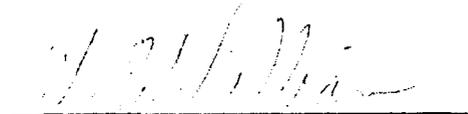
Total Pages: 56

AEROSPACE CORPORATION  
TECHNICAL EVALUATION OF GENERAL ELECTRIC COMPANY  
PERFORMANCE ON  
THE MOL PROGRAM

30 June 1969



J. R. Henry, Director  
GE Segment Office  
MOL Division



W. C. Williams  
Vice President, General Manager  
MOL Division

~~SECRET/DORIAN~~

~~SECRET/DORIAN~~

BIF-107-50250-69

Page 2

INTRODUCTION

This report presents in summary form a technical assessment of the General Electric Company Missile and Space Division's progress and performance on the U. S. Air Force Manned Orbiting Laboratory (MOL) Program.

The time span of activity covered by this assessment is from 1 September 1966 to 10 June 1969. This evaluation is based upon the GE Statement of Work and, where required, the GE Program Work Breakdown Structure (PWBS).

~~SECRET/DORIAN~~

~~SECRET~~/DORIAN

BIF-107-50250-69  
Page 3

SUMMARY

This document contains the Aerospace Corporation evaluation of the status of the GE Contract No. AF18(600)-2955 for MOL; no attempt was made to segregate between work on the white and black contracts. The schedule baseline used as a basis for evaluation is the so called Fiscal 69 baseline schedule as of 13 February 1969.

The evaluation in this document includes both quantitative and qualitative data. Each major section of this document includes a qualitative narrative evaluation. In addition, there is detail quantitative backup data on those subtasks that sufficient visibility was available to the responsible Aerospace Corporation engineer to permit a confident evaluation. No evaluation is given for the management tasks; the technical tasks only were evaluated.

In general, the General Electric engineering effort was on the FY 69 schedule. Due to the Project Upgrade activities and the 1968 rescheduling due to fiscal funding limitations, the bulk of the engineering effort did match the required pace. Areas which were behind the pace required by the negotiated schedule are given in the subsequent sections.

~~SECRET~~/DORIAN

BIF-107-50250-69  
Page 4

SOW TASK 11.0 SYSTEMS ENGINEERING

11.0 Evaluation of Systems Engineering Tasks

In summary, GE had not performed as much of the systems engineering required for a program of the complexity of MOL, and were behind in many efforts as described below.

An example of good systems engineering done by GE was the overall Tracking Mirror drive analyses for stability and performance, which is a portion of the Navigation and Control effort required.

Examples of the behind schedule systems engineering efforts were the alignment system (both ground and airborne), which had to be redirected late in the program, airborne software evolution processes, which were not well organized until the last month, acquisition scope performance and error analyses, which were 3-4 months behind, thermal analyses, which were 3-4 months behind, and contingency modes analyses, which were very late as described in the detailed backup material to follow.

11.1 Evaluation of Operational Systems Engineering

The General Electric Company was behind schedule in the way of analyses concerning the operational system. Some studies were completed for test planning and operation but, on balance, most of this effort has been deferred throughout the program and probably 5-10% of the total program effort had been completed to date.

~~SECRET~~/DORIAN

~~SECRET~~/DORIAN

BIF-107-50250-69  
Page 5

### 11.2 Evaluation of Software Systems Engineering

The General Electric Company was behind schedule in the software effort primarily due to a lack of organized systems engineering. The last three months of the contract had seen a great deal of activity taking place at GE to organize a scientific simulation of the airborne equations and logic, which was a major task of systems engineering required for CEI 802. A similar effort was needed for CEI 804, but was not yet started.

The Part I specs are summarized in the detailed analyses which follow, and this portion of the task was nearly completed.

It appears that in this total systems engineering area, GE would have been behind schedule and was having difficulty in meeting baseline milestones for software without a considerable extra "catch-up" effort. Weighted over the total task, GE was approximately 7 months behind the baseline schedule.

### 11.3 Evaluation of Systems Studies and Analyses

The real bulk of the systems engineering effort at the General Electric Company is described in the above section and in this section of the Statement of Work.

~~SECRET/DORIAN~~

BIF-107-50250-69  
Page 6

GE has always performed timely analyses of control system performance which was a major part of the total systems engineering job and was 90% completed in all aspects. For this reason, GE was probably 60% complete in the effort described in this section of the Statement of Work.

11.4 Evaluation of Systems Integration Engineering

GE had divided their effort in the area of integration and interfaces in such a way that their engineering effort in support of the MPS level was shown against this Statement of Work item. This effort had been deferred prior to January, 1969, and mostly planned for the future. For this reason, it would be difficult to estimate precisely how much had been accomplished in this area. Most likely, not more than 10%.

11.5 Evaluation of Systems Performance Design Requirements

The title of this section of the Statement of Work is a misnomer as this work relates to test planning activities and documentation. As the following detailed backup shows, the ground test plan and test requirement documentation for development testing was nearly completed (90%). The test planning for the engineering vehicle, systems qualification vehicle, and for the flight vehicles had not been started.

~~SECRET/DORIAN~~

~~SECRET~~/DORIAN

BIF-107-50250-69

Page 7

11.6 Evaluation of Interface Control

The actual GE Program Office effort concerned with associate contractor interface negotiations, such as TSOM's, was covered by this task in the Statement of Work, and although this would be a continuing effort throughout the life of the program, the major "bow wave" of activity was essentially passing at the point in the program of cancellation and, hence, this total effort may be estimated at 50% complete and, in general was well managed and conducted after the Systems Office re-organized the effort and instituted Technical Signoff Meetings (TSOM).

11.7 Evaluation of Systems Engineering Support and Services

As the backup detail indicates, this was primarily two tasks; higher level of assembly tests and support of the crew interface working group. The higher level of assembly tests had been deferred and work was just starting up. A much smaller effort (which was the crew interface working group and less than 5% of the total task effort) was 75% complete.

11.8 Evaluation of Systems Effectiveness Engineering

Varying degrees of systems effectiveness studies, math modeling, reliability computation, etc. had been performed. The detailed breakout is shown in the backup material, and it is expected that the analytical effort would have phased out very shortly in the program. An effort which would have been continuing is the "parts, materials, and processes control program". This effort was needed to develop and produce the hardware. On the balance, it is estimated that this task was about 70% complete at the time of termination.

~~SECRET/DORIAN~~

BIF-107-50250-69  
Page 8

11.9 Evaluation of Simulator/Trainer Systems Engineering

As the backup material indicates, varying degrees of this task had been completed. Most of the analytical work, which is covered by this task, was in an advanced state of completion. Much of the documentation was also, certain crew training requirements were barely begun, and planning for higher level of assembly and flight had not been started. Because these latter activities would have required a lower level of engineering manpower, the task is estimated to be 80% complete.

11.10 Evaluation of Support Module Study (Phases 1A and 1B)

This task had been completed.

11.11 Evaluation of CPIC for AVE System Module per 34057

This task was the software integration task which had only barely begun, and was primarily planned to build up in the next fiscal year and would have lasted throughout the flight program. Some planning effort had been accomplished and a good deal of work was underway with McDonnell Douglas Astronautics. The effort is estimated to be 10-15% completed.

11.12 Evaluation of Testing and Installation of Light Trap Material

This task does not seem to be systems engineering oriented; however, it is assumed that the Contractor would provide the actual hardware installation, manufacturing, quality control, etc. against Section 12 of the Statement of Work. As far as analytical aspects of the light trap studies, the activity was 80% completed with the only remaining activity assessment of IF reflectance on IVS performance.

~~SECRET/DORIAN~~

GE WORK TASK STATUS ESTIMATES

10 June 1969

11.0 SYSTEMS ENGINEERING

11.1 Operational System Engineering

11.1.1 Requirements for test planning & operation

Although effort is overdue, an organization was only recently established (May 69) to perform this task. Estimated completion - 20-30%.

11.1.1(d) Launch Crew Certification Training

There is no indication that any effort has been applied to this task.

11.1.2 System Performance Degradation per 20021

0%. No data has been submitted in fulfillment of this task. (Selection of critical parameters for test to test data comparison).

11.1.3 Development Flight Implementation Studies

Completed.

11.1.4 Post Flight Evaluation per 34056

0%.

11.2 Software System Engineering

11.2.1 Part I Specifications

- a. 802A Completed
- b. 804AI "
- c. 805A "
- d. 807A "
- e. 801A "
- f. 809A Preliminary draft submitted - not approved
- g. 804A 0%

11.2.2 System Analyses

- a. Acquisition & Tracking Models  
40% at time of TR (26 May), Aerospace deck put it 50% complete (toward scientific simulation)
- b. Equations & Logic  
Part II 60% complete (April baseline).

11.2.3 Space/Ground IAC

Submitted draft of the interface spec. Small portion of total effort complete - approximately 5.0%.

GE Work Task Status Estimates - 10 June 1969

11.2.4 On-Orbit Ephemeris Error Studies  
(To start July 1969)

5%

11.2.5 MDS Software

65% (Phase 0 was 100% completed. 50% of Phase 0 was applicable to Phase 3. Also, 15% of new Phase 3 work was completed).

11.2.6 Special Test Software  
(for use with 802)

Effort about 30% completed.

11.2.7



a. Software changes

Report submitted on effort to date. Task effort considered no more than 50% complete.

b. Simulator changes

Requirements study - complete ) 50%  
Implementation study - 20% )

c.



11.3 System Studies & Analysis

11.3.1 Refine MMSS Requirements & Prepare Part II Specifications

a. MPS Analyses

N & C area  $\approx$  75% )  $\approx$  50% ) Just getting organized  
All others  $\approx$  30% ) using notebook

b. AGE Verification Test Analyses

10% - Very few design/performance verification tests have been performed.

c. MMSS Qualification Test Analyses

0% - No system level qual tests have been performed.

d. Mission Analyses

10% (Was to be part of scientific simulation, sequence definition effort & 804 studies).

e. Navigation & Control Analysis  
(Pointing accuracy & image rate prediction)

99%.

GE Work Task Status Estimates - 10 June 1969

11.3.1 (Continued)

- f. Crew Timeline & Target Access  
Sequence Definition Working Group 25% complete
- g. Photo Access Capability  
90% complete (only alignment not done).
- h. Structural Dynamic Analyses  
Complete to date. Submitted 1st of 10 S017 items.  
∴ 11.3.1h is estimated to be 15% complete.
- i. OV Alignment Analyses  
20% of final task completed; however, considerable  
previous effort was wasteful.
- j. Ordnance System Analysis  
Completed.
- k. DRV Analyses (thru 5/67)  
Completed.
- l. MMSS Acceptance Test Analyses  
0% - No acceptance tests have been performed on  
MMSS hardware.
- m. ATS Performance Prediction  
Estimated to be 50% complete.
- n. Materials Analysis  
Task effort satisfactory to date - to have continued  
for life of contract.
- o. IVS Performance Prediction  
Work estimated 50% complete.

11.3.2 Mission Performance Analyses

- |    |   |       |                                  |
|----|---|-------|----------------------------------|
| a. | TM Drive Effects                                | 99% ) |                                  |
| b. | Digital Computer Effects                        | 10% ) |                                  |
| c. | ACTS Contr Sys Char                             | 99% ) |                                  |
| d. | Dyn Coupling TM to OV                           | 95% ) |                                  |
| e. | Crew Corrections to Pointing<br>& Tracking      | 95% ) | Weighted Sum<br>$\bar{E} = 60\%$ |
| f. | IVS Noise & Char.                               | 35% ) |                                  |
| g. | Thermal Distortion of TM                        | 35% ) |                                  |
| h. | Alignment Changes including<br>On-Orbit Thermal | 10% ) |                                  |
| i. | Effects of Vibrations                           |       |                                  |

~~SECRET~~/DORIAN

BIF-107-50250-69  
Page 12

GE Work Task Status Estimates - 10 June 1969

11.3.2.1 Dipole Moments

0% - Task to be omitted.

11.3.2.2 Describe Protuberances

Complete.

11.3.3 FV Timeline Reports

Two out of 8 submitted.

11.3.3.1 Development Flight Support  
(Sys Engr'g Operations & Hardware Integration)

A continuing effort - estimated to be about 50% completed.

11.3.4 Contingency Analyses per 10032 & 30002

Two token reports submitted to MDAC-WD. No meaningful content. No meaningful effort expended. Detailed instructions and work was to have been completed in July 69 (Total effort about 5% completed).

11.3.5 Analyses of System Development & Qualification Tests

10% - Development tests were barely started.

11.3.6 Mission Contingency Performance Analysis

Little known effort performed. Effort estimated to be less than 10% completed at most.

11.3.7 Engineering Analysis Reports

- |                        |                                |
|------------------------|--------------------------------|
| a. Nav & Control       | 1 of 2 & acceptable (50%)      |
| b. Command             | 1 of 2 but it was unacceptable |
| c. EP & SD             | 1 of 2 submitted               |
| d. Displays & Consoles | 5% (Complete design change)    |
| e. Alpha               | About 50%                      |
| f. Beta                | 0%                             |
| g. Instrumentation     | 1 of 2 submitted               |
| h. Env'l Control       | 1 of 2 submitted               |
| i. Structures          | 1 of 2 submitted               |

11.3.8 Dynamic Analysis for EK

Complete to date (10 June). ∴ 11.3.8; 20% complete, based on one of 5 reports submitted

~~SECRET~~/DORIAN

GE Work Task Status Estimates - 10 June 1969

11.3.9 Analytical Support for COA & MM Dynamic Testing

SDM-1 (COA) 100%  
OV Modal Survey Requirements 50%  
MM Dynamic Survey 0%  
∴ 11.3.9 50% complete

11.3.10 Thermal Power Consumption Studies

a. Door open time	70%	(Reference:
b. Power requirements	80%	B107-50139-69,
c. Subsolar openings	0%	28 Mar 69)
d. Shadow cooling	0%	

11.3.11 ATS Off-Axis Performance

0%.

11.3.12 Crew Performance Prediction

0%

11.3.13 Mass Properties Control per 24016

Overall effort estimated to be 64% completed.

11.3.14 Power Analysis per 30001

Reports submitted every 3 months for life of program.  
23% completed.

11.3.15 Nav & Control Improvement (TM LOS Accuracy)

10% complete because analysis was not major means.  
DSS-1 testing was to be the way to work out methods.

11.3.16 EMC Analysis

a. GBQ	10% completed
b. (MA)	25% completed
c. (A)	0% completed.

11.3.17 Contamination (Define MM levels and approaches for reducing)

10%

a.	No effort in terms of actual analysis up to and including program termination.
b.	Effort has been made for GE equipment only. Materials were controlled to minimize impact of contamination. No equipment degradation levels were established for associate contractors' equipment. For a few components (star tracker and thermal coatings), levels were degradation were established.

~~SECRET~~/DORIAN

BIF-107-50250-69

Page 14

GE Work Task Status Estimates - 10 June 1969

- 11.3.17.1 Ground Contamination  
(Prepare and implement Contamination Control Plan)  
Completed. The contractor has fulfilled the requirements of this task.
- 11.3.17.2 Launch, Ascent and Orbit Phase, Contamination  
(Identify contamination sources due to GE equipment). 20%
- a. No formal identification made other than the data from AEDC tests, T-III known sources and RTV 1016 outgassing. Thus, proper design has not been implemented.
  - b. Allowable flight contamination levels for GE-sensitive equipment had not been established.
- 11.3.17.3 Degradation Analysis  
10% completed. Little effort has been possible on this task since the contaminants and their distribution had not been completely identified.
- 11.3.17.4 Integrated Development Support  
(Support DAC Contamination Test Program)  
100% completed. The contractor has been fulfilling this task. Work was completed in support of the plume test program.
- 11.3.18 Power Quality Analyses  
5% Completed. Reports were being submitted every 3 months for life of program.
- 11.3.19 Radiation Analysis  
0%. No effort expended, primarily due to Systems Office delay in providing GE with specific guidance as to levels of radiation.
- 11.3.20 Non-Metallic Materials Analysis  
The contractor was proceeding at an acceptable rate up to program termination. 30%
- 11.3.20.1 Identify those requiring sample testing  
Completed.
- 11.3.20.2 Requirements for special tests per 14002  
Complete and satisfactory.

~~SECRET/DORIAN~~

GE Work Task Status Estimates - 10 June 1969

11.3.20.3 Full-Scale Test Requirements

Complete and satisfactory.

11.3.20.4 Identify non-metallics in MM

No significant effort. Methodology was not presented to SO, no tabulation, no interface analysis.

11.3.20.5 Identify non-metallics in LM and support interface analysis

Completed identification of materials. No effort expended on interface analysis.  $\approx 25\%$

11.3.20.6 Identify required non-metallic material changes

No formal report submitted. Did not meet identification deadline.

11.3.21 GE-AVE Alignment System Design Studies

Preliminary design study estimated to be 90% complete toward PDR. Total analysis task 40%

11.4 System Integration Engineering  
(Planning, Analysis and Support for MPS)

Engineering effort (according to progress report) is against this one. This is a continuing effort - 2 years complete, 3 years to go?

11.5 System Performance Design Requirements

11.5.1 System Test Requirements for MMSS AVE  
(Development, acceptance, and qualification)

- |    |                  |                |
|----|------------------|----------------|
| a. | Top Level (GTP)  | 90% complete.  |
| b. | DSS-1 Test Rqmts | 50% complete.  |
| c. | 113D Test Rqmts  | 100% complete. |
| d. | 113T Test Rqmts  | 100% complete. |
| e. | 114 & 115        | 0%             |
| f. | 118 - 122        | 0%             |

11.5.2 System Test Requirements for Flight Test

Effort estimated to be 50% completed.

11.6 Interface Control

11.6.1 Define & Maintain per IF-100 and IFS-100001

The total effort is estimated to be 50% completed.

11.6.2 Provide DRC Interface Support

Effort is estimated to be 80% completed.

~~SECRET/DORIAN~~

~~SECRET/DORIAN~~

BIF-107-50250-69  
Page 16

GE Work Task Status Estimates - 10 June 1969

11.6.3 Review at AF direction ECP's from others

Little if any effort.

11.6.4 Comply with 20005/30035

A late SOW requirement - never implemented.

11.6.5 Support DAC in Preparation of LV Acceptance Test  
Specification & EK in Preparation of MM Acceptance Test  
Specification

10% - Task had really just started (LVITRS).

11.7 System Engineering Support & Services  
(for LV tests at DAC and MM tests at EK)

0%

Support crew transfer working group

Task estimated to be 75% complete.

11.8 System Effectiveness Engineering

11.8.1 Implement 10032/30002

0%

11.8.1.1 Develop system effectiveness math models

Basic model developed per "new" definition and one  
satisfactory input provided to DAC. Semi-annual updates  
remain through program.  
60% complete.

11.8.1.2 Develop inputs to PLOT

Same as 11.8.1.1.  
60% complete.

11.8.1.3 Provide apportionment to subsystems

Basically complete. Minor updates expected.  
95% complete.

11.8.1.4 Define reliability program, perform reliability  
analysis, FMEA, etc.

Basic analyses, initial versions of FMEA's complete.  
Updates were required for CDR, flight.  
60% complete.

11.8.1.5 Maintainability program and Maintenance  
Demonstration Plans

Basic planning complete. Demonstration aspects NOT

~~SECRET/DORIAN~~

~~SECRET~~/DORIAN

BIF-107-50250-69

Page 17

GE Work Task Status Estimates - 10 June 1969

11.8.1.5 (Continued)

complete. Maintenance procedure/analysis effort barely started on a formal basis.  
25% complete.

11.8.1.6 Crew Safety Analyses.

Estimated to be about 20% completed.

11.8.1.7 Human Factors Requirements

Completed.

11.8.1.8 Contingency Modes Analyses

Two token reports submitted to MDAC-WD. No meaningful content. No meaningful effort expended. Detailed instructions and work was to have been completed in July 1969.  
5% complete.

11.8.1.9 Utilize effectiveness models to assess MMSS effectiveness for each flight

Assessment - Only the plan was completed. No assessment done as such.  
10% complete.

Studies, etc. - Backup studies done, other studies probably completed to CDR level.  
60% complete.

11.8.1.10 Crew Capability Report

0% - Report was never submitted.

11.8.1.11 Integrate effectiveness analyses with crew simulation and training

50% complete. (MDS - 80%/MMSE - 20%)

11.8.1.12 Parts, Materials & Processes Control Program (P/M/P)

11.8.1.12.1 Develop AVE Selected Parts Lists

Estimated 85% complete.

11.8.1.12.2 Develop AGE Selected Parts Lists

Estimated 95% complete.

11.8.1.13 Operate an Integrated Test Program Board (ITPB)

Estimated 10% complete.

~~SECRET/DORIAN~~

BIF-107-50250-69  
Page 18

GE Work Task Status Estimates - 10 June 1969

11.9 Simulator/Trainer System Engineering

11.9.1 Provide system integration engineering for simulators  
50% complete (MDS - 80%/MMSE - 20%)

11.9.2 Establish Part I Specifications CP1400I/CP1460I/34003  
100% complete (Signed off 8/68)

11.9.3 Assure EK Requirements are reflected in GE-DAC  
simulator interface specification  
95% complete (Specifications signed 3/68,  
some TBD's).

11.9.4 Establish crew training requirements  
10% complete.

11.9.4.1 Analyze training requirements of crew for MPS  
and software  
0%.

11.9.4.2 Provide integration and coordination of MPS training  
and simulation activities  
0%.

11.9.5 Post Pass Telemetry study for mission simulator  
10% complete.

11.10 Support Module Study, Phases 1A and 1B  
Completed.

11.11 CPIC For AVE System Module per 34057  
Overall effort estimated to be 15% completed.

11.12 Testing and Installation of Light Trap Material  
Interface agreement completed. Task not actually  
accomplished.

~~SECRET/DORIAN~~

~~SECRET/DORIAN~~

BIF-107-50250-69  
Page 19

SOW TASK 12.0 AVE HARDWARE

To some extent the Statement of Work (SOW) does not parallel either the Program Work Breakdown Structure (PWBS) or the GE AVE CEI Specification (CP 1000 AI). In order to evaluate the status of GE contract effort in this area a format departure is made from the SOW to the subsystem level for SOW subtask 12.1 which provides for design, development, manufacture, qualification and acceptance testing of all GE AVE in accordance with the Deliverable Items List (DIL).

On the FY69 schedule CDR and flight hardware drawing release was scheduled for late CY 1969 and early 1970. Consequently comments contained herein are directed to completion of design and development of test models. Where the development design effort was lagging and, potentially, would impact CDR this is noted subsequently.

1. TASK 12.1

A. Acquisition Telescope System (ATS)

While much detailed design has been completed on the ATS, many aspects of the design still required an addendum PDR.

Much of the design has changed since PDR and the interface definition was just being defined. Specifically, (1) the thermal interfaces were just being established, thus, a modified thermal design was required; (2) mechanical interfaces were recently established and detailed shroud design concepts were to be established; (3) design to protect against sun hazards required extensive modification; and (4) the ATS alignment design had not been started. The left-hand stick design was being completely redesigned. The crew restraint and eyepiece protection devices were just now in the conceptual design phase; optical performance was not yet specified, particularly the off-axis performance; much additional analysis relative to jitter performance was required which would probably result in detailed ATS mechanism modifications.

~~SECRET/DORIAN~~

~~SECRET/DORIAN~~

BIF-107-50250-69  
Page 20

Furthermore, during the subcontractor PDR, many deficiencies in the design had been noted. An ATS addendum PDR was planned for early summer 1969.

1. Main ATS Drive Electronics

Detailed drawings for the modules making up the main drive electronics were 80-90% released. Engineering units of many of the modules had been fabricated and tested, but not as a complete subsystem. Some of the electronic design had been tested on the ATS Drive brassboard. Electronic design was still being optimized for jitter performance.

2. Auxiliary ATS Drive Electronics

Detailed mechanical design was about 90% complete. Considerable redesign of electronics would be required to reduce magnitude of jitter performance and an indication that specular reflections could be hazardous. The electronic design was perhaps 60% complete.

3. Lab-Module Mode Controller

Mechanical design for this unit was completed and fabrication of test unit was under way. Electrical design probably 60% complete.

4. Scanner

The scanner mechanical design was 80 to 90% complete. The engineering model was in fabrication and near completion. Some redesign might have been required to solve jitter problems.

5. Fixed Fold and Window Mount

Although GE reported the design of this unit as complete as of May, much redesign was probably required to solve problems associated with jitter, thermal requirements, and crew hazards. Would consider the design only 50% complete.

6. Shroud

Shroud conceptual designs completed, but mechanical interfaces agreements were just being approved which would permit the detailed design to proceed. Design less than 25%.

~~SECRET/DORIAN~~

~~SECRET~~ DORIAN

BIF-107-50250-69  
Page 21

7. ATS Drive Gyro

Gyro design had proceeded through CDR with only a few action items left open.

8. Telescope

Optical design was completed in 1967. Bench tests, completed in May, had confirmed the design (at least on-axis performance). Mechanical designs for the engineering models were substantially completed. However, the mechanism designs were quite crude and required extensive redesign. Also, some structural redesign would probably be required as a result of the jitter problem and was just beginning to be isolated.

9. Thermal Design

Thermal requirements for satisfactory ATS performance had been determined. A passive thermal control system to satisfy the requirements had been attempted, however, it appeared that such a design was impractical. GE had proposed a thermal interface compatible with the MDAC environmental control system. This interface would have required active ATS thermal control and possibly a focusable reticle. The detailed thermal design is about 25% complete.

10. Eye Hazard Protection

To protect against direct sun-viewing through the ATS, a sun sensor/shutter mechanism had been designed. As of May 1969, a conceptual arrangement which gave adequate coverage had been proposed, but the detailed design was just starting. The status of the shutter design is not known, but it would probably have to be redesigned as a result of the requirement, just identified, to protect against viewing, not only the sun directly, but also specular reflections from the ground.

11. ATS Testing

No test vehicle tests have been performed on the ATS equipment. Breadboard tests of MDKE and ADKE are complete. The EMK design is 90 to 100% complete on all items, except the shroud.

~~SECRET~~ DORIAN

12. Visual Display Projector (VDP) and Module (VDM),  
VDM Storage

The design of the VDP/VDM is approximately 85% complete. This includes the left-hand unit which is about 95% complete, and the right-hand unit which has not been started, but is essentially a mirror image of the left-hand unit. No units have been delivered. The VDP/VDM development and qualification testing had not started.

The design and fabrication for the VDM storage in Console 2A for DC-1 was 100% complete. The DC-1 testing should be complete; however, the test report has not been received.

B. Controls and Displays/Crew Interface Equipment

In this section, the status of the Crew Interface Equipment will be described. This equipment includes Controls and Displays, the Left-hand Control Stick (part of N&C), the head restraints and the panel protection equipment. The equipment in this area was essentially on schedule.

1. Panel Components, Standard

Most panel components were standard as specified in SAFSL 10011 (Crew Compatibility Criteria Document). As such, MDAC-WD was responsible for their ground testing. However, GE was preparing their own procurement specifications. These specifications are about 90% complete.

2. Electroluminescent Overlays

The development of the overlays is essentially completed. Sample units have been subjected to environmental tests and passed successfully.

3. Panel Designs and Fabrication

In this discussion, "panel" includes the design of the panel structure with mounting provisions for the standard components (see 1.) thereon for Consoles 2 and 8. It does not include special panel-mounted equipment such as VDP's, restraints, protection equipment, and the right and left hand sticks; then, will be covered separately.

The design requirements of the panels for the 114 vehicle had been presented to the SO and approved, except for minor points in March, 1969. The detailed design is in process and is 80 to 90% complete. It is believed that 80 to 90% of the 114 detailed design would be applicable to the 118 vehicle. Fabrication of panels for the 114 vehicle had started. Percentage completion is not known, but would be estimated to be about 10% or less.

4. Right-Hand Stick

The engineering model had been fabricated and tested. Detailed design of flight equipment was probably 75% complete. Design was being strengthened to withstand 150 lbs static loads, enlarged to accommodate encoders having redundant lamps and electronics, and modified to include "feel" feedback when stick deflection approaches the end-stop region.

5. Left-Hand Stick

Detailed design was about 80% complete. The molded grip had been fabricated and was ready to be reviewed by the flight crew for user acceptability. Engineering models had been fabricated and tested on the simulator. Design was in process of optimization.

6. Head Restraints and Panel Protective Features

Conceptual design completed, but detailed design just started - perhaps 10% complete. No testing of these designs had been performed.

7. Monitor and Alarm

The design had progressed to point where detailed interfaces had been agreed to with MDAC. It is estimated that hardware design was about 80-90% complete.

8. Crew Interface Equipment - Test

The CEI test vehicle testing had not started. The design and fabrication of Console 2 and 8 - Panels A, B, C, D, E, and H for 103L and 105 are complete and for DC-1 is 80-90% complete. The 114 design is approximately 80% complete. "Typical" panels have been designed and fabricated and subjected successfully to component development environmental tests.

~~SECRET/DORIAN~~

BIF-107-50250-69

Page 24

C. Communication, Command and Instrumentation Subsystem (CC&I)

In the GE AVE CEI Specification the design requirements for the CC&I subsystem were described under the Command Subsystem and the Telemetry Subsystem and their status herein is evaluated by that breakdown. In general, the CC&I subsystem was proceeding on schedule without any major problems.

Command Subsystem

MDAU

Brassboard and E-1 Units were complete and undergoing test in DSS-1. MDAU-computer and MDAU-PCM telemetry interface tests have been successfully completed.

E2 and E3 units subassembly were completed 5 June 1969 with final assembly scheduled for 13 June 1969.

The CDR package was released and received at the SO for review.

Experiment Controller

Development tests were completed on unit DC-2. Test report was received and indicated that overall performance was excellent. Unit presently in DSS-1 testing.

Display Console Controller

DC-1 Development Model unit was delivered for DSS-1 testing.

Telemetry Subsystem

A development PCM telemetry system has been delivered and is now operating in the DSS-1 assembly. The CDR has not yet taken place and qualification testing has not been performed. The housing for the production units was in process of being redesigned and there is no indication that qualification or production units have been fabricated.

The analog/FM encoder development unit had been developed but was rejected due to technical specification non-compliance. The development unit was resubmitted for acceptance within the past two weeks. No CDR has been held nor production hardware fabricated. However, long lead time items had been scheduled for procurement.

~~SECRET/DORIAN~~

D. Electrical Power and Signal Distribution (EP&SD) Subsystem

The Electrical Power and Signal Distribution Subsystem as proposed and designed by General Electric Company would in general comply with the task as stated in the Mission Module CEI and General Electric Company Statement of Work. At the time of contract termination the Electrical Power and Signal Distribution Subsystem was four months behind schedule.

The only major problem that exists in the subsystem is that the power controller was unable to contain all of its required function and equipment. General Electric Company was in the process of redesign of the Power Controller.

The four month delay was caused by numerous minor design and test problems in the EP&SD Subsystem.

1. Design Status

Internal EP&SD designs which include the Power Controller, Experiment Power Conditioner, Separation Controller, Baroswitch, and Arm/Disarm Devices are 75% complete. Interconnecting wiring is 50% complete. IFS/ICD documentation is 90% complete.

2. Test Status

<u>Hardware</u>	<u>Brassboard Tests</u>	<u>Component Tests</u>	<u>DSS-1</u>
Power Controller	100%	90%	0%
Separation Controller	100%	100%	50%
Experiment Power Conditioner	100%	0%	0%
Baroswitch	100%	100%	50%
ARM/DISARM Device	100%	100%	0%

3. Harness Status

Lab Module wire harness development on 103L started February 1969. Drawings for the preliminary interconnecting cabling diagram are 100% complete. Mission Module wire harness development on 103M vehicle is 65% complete. Drawings for the interconnecting cabling

~~SECRET~~/DORIAN

BIF-107-50250-69  
Page 26

diagrams are 100% complete. Telemetry and command subsystems harnesses for DSS-1 are 100% complete. EP&SD Subsystem DSS-1 harness are 50% complete. Interconnecting cabling diagrams for the 113D vehicle are 100% complete and harness assembly drawings are 100% complete. Interconnecting cabling diagrams for the 113T vehicle are 100% complete and harness assembly drawings are 95% complete.

E. Thermal Cover Drive Subsystem

The Thermal Cover Drive subsystem as proposed and designed would in general comply with the tasks as stated in the AVE CEI and the General Electric Company Statement of Work. At the time of contract termination, the system was approximately three (3) months behind schedule.

There were two major problem areas within the drive subsystem, (1) door position indicator wheel would not register zero at the end of an open/close cycle and (2) the mechanical stops as designed to restrain a run-away door would not do so. General Electric Company was in the process of recommending solutions to these problems. These problems are inter-related with the Structures Subsystem.

1. Design Status

The design was approximately 75% complete.

2. Test Status

The breadboard testing is 100% complete, development component testing is 95% complete and DSS-1 testing has not been initiated as yet.

F. Image Velocity Sensor (IVS) Subsystem

The Image Velocity Sensor (IVS) subsystem, consisting of an IVS and an analog to digital (A/D) converter, would probably have marginally complied with the Contract End Item (CEI) Specification. At program cancellation, GE was approximately two (2) months away from making an IVS vendor selection. As such, the IVS program was at least four (4) months behind the FY 69 schedule. Technical design problems in each of the two IVS units still in competition caused the delay.

~~SECRET/DORIAN~~

BIF-107-50250-69  
Page 27

Because the IVS vendor had not been selected, no progress had been made towards development component or DSS-1 design or hardware fabrication.

G. Tracking Mirror Drive Subsystem

The Tracking Mirror Drive System has generally been on schedule. Present analysis and hardware tests to date indicate that the TM Drive would meet the CEI specification requirements. There are two questionable performance areas; these are:

- a) TM Drive [REDACTED] was being met with margin except for possible effects of bearing cocking which was still under evaluation.
- b) TM Drive Stability - The drive was stable contingent on Associate Contractor signup of identified structural and mass parameters.

1. Design Status

The design was 90% complete. GE did an excellent job in developing super smooth ball bearings for this drive. The primary bearing and lubricant design was 90% complete. Backup lubricant development and test was 30% complete.

2. <u>Test Status</u>	<u>Brassboard</u>	<u>Dev Comp</u>	<u>DSS-1</u>
<u>Hardware</u>	<u>Testing</u>	<u>Testing</u>	
Bearings	100%	10%	0%
Torquers	100%	50%	0%
Encoders	0%	20%	0%
Electronics	80%	50%	0%
Boost Regulator	100%	100%	0%
Mode Controller	100%	100%	0%

~~SECRET/DORIAN~~

~~SECRET~~/DORIAN

BIF-107-50250-69  
Page 28

H. Fine Attitude Reference (FARS) Subsystem

The Startracker portion of the FARS was on schedule and 30% complete. However, several major changes were being worked and General Electric had not determined if the CEI Specification could be met in light of these changes. Thus a schedule delay was possible.

The Flight Alignment Monitor System (FAMS) portion of the FARS was on schedule and about 15% completed per the latest negotiated contract. GE has just selected one sensor subcontractor and built a breadboard model of the other sensors. At cancellation time, GE had not determined the requirements for the GE sensor. It should be noted that GE was given the opportunity to discard their original unworkable FAMS design at the November 1968 contract negotiations, which helped them out of an earlier schedule problem.

The Low 'g' Accelerometer (LGA) had completed PDR successfully. All work and reports were on schedule. The GE mission operation of the LGA was just beginning. The overall LGA task was about 20% complete.

I. <u>Test Status</u>	<u>Brassboard Testing</u>	<u>Dev Comp Testing</u>	<u>DSS-1</u>
<u>Hardware</u>			
Startracker	NA	20%	0%
HiRange Align. Sensor	0%	0%	0%
LowRange Align Sensor	100%	0%	0%
Low G Accelerometer	NA	70%	0%

I. Structural Subsystem

The GE AVE structural and environmental subsystem has had an incremental preliminary design review and in general the design is finalized except for the Startracker support. The status of this GE AVE subsystem in satisfaction of the GE AVE CEI MOL 010AI and MOL 010BI is as follows:

~~SECRET~~/DORIAN

~~SECRET/DORIAN~~

BIF-107-50250-69

Page 29

1. Laboratory Module Structures

The main GE structural components in the Laboratory Module are the Console 2 and 8 birdcages which provide support for payload control equipment. Cold plates, which are attached to the consoles, are used as heat exchangers and as mounting bases for this equipment. The design and analysis tasks on Consoles 2 and 8 and on the cold plates is 100% complete. Consoles 2 and 8 have been mocked up in 102L and 103L.

2. Mission Module Structure

The main GE structural components in the Mission Module are:

- a. Tracking mirror support assembly
- b. Sliding mask structure
- c. Mechanical stops
- d. Manual drive
- e. Fixed mask
- f. Equipment trays
- g. Startracker fairing
- h. Startracker mount.

A. Tracking Mirror Support Assembly

The Tracking Mirror Support Assembly had been completely designed and one aluminum and three beryllium assemblies have been manufactured. However, due to an increase in launch loads, this component had to be slightly redesigned. The design for the modification has been completed, and also the design is complete for the retro fit kits which were to be used on the units already manufactured.

B. Sliding Mask Structure

The Sliding Mask Structure Assembly has been completely designed (100%). The interfaces with the Mission Module Primary Structure (MMPS) have been defined. The designs for the rails, saddles, rollers, stops and the manual drive have been completed. Fabrication of three development units has been completed. 50% of the development testing has been successfully completed.

~~SECRET~~/DORIAN

BIF-107-50250-69  
Page 30

C. Fixed Mask

The design for the Fixed Mask was less than 50% completed. However, the interface with the MMPS has been defined.

D. Equipment Trays

The design of the Equipment Trays for support of the electronic equipment on both sides of the Mission Module Aft Section (MMAS) is 100% complete.

E. Startracker Fairing and Mount

The Startracker Mount and Fairing have been completely designed but as the result of an updated pointing accuracy analysis, a change in the mounting concept of the Startracker has been initiated. This change would have resulted in a change in the method of mounting the Startracker and a change in the fairing design. The latest design concept was under evaluation and was about 50% complete at program termination.

2. TASK 12.2  
No evaluation is provided for this task.
3. TASK 12.3  
No evaluation is provided for this task.
4. TASK 12.4  
No evaluation is provided for this task.
5. TASK 12.5  
No evaluation is provided for this task.
6. TASK 12.6  
No effort has been expended as yet.
7. TASK 12.7  
No effort has been expended as yet.
8. TASK 12.8  
This task is 100% complete.
9. TASK 12.9  
This task is covered in 1.F above.
10. TASK 12.10  
This task is covered in 1.C above.
11. TASK 12.11

~~SECRET/DORIAN~~

BIF-107-50250-69  
Page 31

SOW TASK 13.0 AGE

1. Mechanical AGE Summary

Of the MAGE, only five (5) items are in the CEI category. Two (2) are major subcontract items; the MM Transporter and the Environmental Control Unit.

The subcontract items are essentially 75% complete. However, a technical design problem in the refrigeration subsystems became apparent during validation/verification testing of the first ECU. Extent of this problem is unknown to Aerospace and may have a serious impact on evaluation of the AiResearch subcontract.

Approximately 75 different MAGE items of the CFE category were under design, development and fabrication for a total of approximately 300 units. Detail status is not available since these items were not included in design review cycles by SO/Aerospace. On the basis of the overall AGE review presentation by the Contractor in March, it is estimated that this effort is 50% complete.

The overall SOW Mechanical AGE task effort is estimated as 55% complete.

2. Electrical AGE Summary

A. CEI Items

The principal CEI's of GE MOL Electrical AGE are the CITE systems and the associated software. A CITE (Computer Integrated

~~SECRET/DORIAN~~

~~SECRET~~/DORIAN

BIF-107-50250-69

Page 32

Test Equipment) system is a set of automatic checkout equipment for the Mission Module System Segment, controlled by a general-purpose digital computer system. The Central Area Equipment (CAE) portion of CITE includes the computer, displays and control consoles, and communication and command subsystems; the Test Area Equipment (TAE) includes signal, command and power equipment which directly interfaces with the vehicle segment. The maximum CAE configuration, including the computer sub system, is equivalent to 48 standard 24" racks; the maximum TAE configuration is the equivalent of 19 standard 24" racks. Design of the CAE is complete; TAE design is at the CDR stage. Computer subsystems for three sets of CITE have been delivered; one set of CAE has been completed and integration testing has begun. Estimated hardware status of CAE sets two and three is 50% complete.

Software CPCEI's connected with CITE are 801A, Diagnostic and Operational Readiness Programs (DORP), and 805A, CITE Test Support Programs. Estimated status of these software programs is: design and coding - 85%; development testing and debugging - 65%; and testing in prototype hardware - 10%.

B. Special Test Equipment

The major items of electrical STE to support the MPSS and their status is as follows:

CITE Unit C/O AGE - Complete  
VTMS Test Set - Complete (1 of 4)  
GAMS Test Set - Pre-PDR  
D Test Set - Complete (2)  
T Test Set - 95% Complete (1 of 2)  
SETE - PDR Only  
R/F Link - PDR Only  
EMI Test Set (TDAS) - Specification ready; none of  
4 Procured.

Over-all status of the electrical STE task is estimated at 45% complete.

~~SECRET/DORIAN~~

BIF-107-50250-69  
Page 33

C. Summary

Based on rack count completed and in test or use,  
the present overall status of the GE Electrical AGE effort is estimated  
at approximately 30% complete.

~~SECRET/DORIAN~~

~~SECRET/DORIAN~~

BIF-107-50250-69

Page 34

GE WORK TASK STATUS ESTIMATES

10 June 1969

13.0 AGE

13.1 CEI's

104A Transporter	S/C item. 1st unit 75% complete; 2nd unit 50% complete.
259 Prime Mover	Buy item. Engr'g complete for modification.
109A Env'l Con Unit	S/C for 3 units. 1st unit 75% complete; total engr'g 85% complete.
235A Umb Duct	Preliminary design only. Seven on contract.
111A Env'l Cond Unit	PDR complete May 1969. Vendor procurement not initiated.
MOL CITE 400A	Central Area Eqmt: Complete - In System test. Test Area Eqmt: Design 75% complete.
MOL CITE 400B	Central Area Eqmt: 75% fabricated. Test Area Eqmt: Design 50% complete.
MOL CITE 400C	Central Area Eqmt: 40% fabricated. Test Area Eqmt: Design 65% complete.
MOL CITE 400D	Central Area Eqmt: 25% fabricated. Test Area Eqmt: Design 60% complete.
411A T/V Test Eqmt (GD-8)	In preliminary design; interface specification in preparation.
410A MCR Console 103	Preliminary Part I Specification submitted; unsatisfactory - not approved.
400E MMTE	Design 50% complete; 20% fabricated.
400F MMTE	Design 50% complete; no fabrication.
400G MMTE (TAE only)	Design 40% complete; no fabrication.

13.1 CFE's

308A Task 3"D" Align Kit	Complete
309A LM Align Eqmt	Estimated design is 5% complete.
311A "A" S/S Align Eqmt	Estimated design is 5% complete.

~~SECRET/DORIAN~~

~~SECRET/DORIAN~~

BIF-107-50250-69

Page 35

GE Work Task Status Estimates - 10 June 1969

13.1 CFE's (Continued)

269A Nadir Position'g Device	Estimated design is 5% complete.
313A S/S "A" Instal'n	Estimated design is 5% complete.
314A S/S "A" Sensor	Estimated design is 5% complete.
315A S/S "A" Center Section	Estimated design is 5% complete.
316A S/S "A" Shroud Installation	Estimated design is 5% complete.
258 MMFS Align Eqmt	10% complete.
224A 2-Leg Sling - MM Sections	3 Units. Fabrication probably complete.
225A MM 2-Leg Sling	3 Units. . Fabrication probably complete.
226A 3-Leg Sling	4 Units. Fabrication probably complete.
203A Hdlg Ring Set	33 rings on order from vendor. Some already delivered.
227A Hdlg Ring Trans Eqmt	Complete.
204A Handling Slings - MM Consoles.	Design 75% complete; no procurement initiated.
229A Aft Sec Dolly	In-house design and manufacture; Engr'g 85% complete. Fabrication on 2 units (out of 9) probably complete.
230A Trunnion Spt	5 Units. Engr'g complete; fabrication probably complete.
207A Vert Spt Stand	5 Units. Engr'g 90% complete; Fabrication on 1st 3 units probably complete.
231A Vert Work Plat	2 Units. Buy item. Engr'g 75% complete. 1st unit probably 50% fabricated.
208A Test Access Pnls	8 Units. Engr'g 80% complete. No procurement.
261A Counter Balance	7 Units. Engr'g 75% complete because redesign required. Fabrication started.
285A Door Dust Cover	In fabrication - 50% complete.

~~SECRET~~/DORIAN

BIF-107-50250-69

Page 36

GE Work Task Status Estimates - 10 June 1969

13.1 CFE's (Continued)

266A Ring Stand & Sling	4 Units. Engr'g 90% complete. Two probably fabricated.
276A Shipping Constraint	3 Units. Engr'g 90% complete. Probably 1 fabricated.
260A Hor Shroud Std	3 Units. Engr'g 90% complete. Probably 1 fabricated.
267A Div Bd Ver Work Platform	3 Units. Engr'g 10% complete. No fabrication.
282A Div Bd WTR	1 - 2% complete. Concept only.
268A Insulation Prot'r & Stand Sets	Engr'g 90% complete. Two or three probably fabricated.
265A Simulator Stand Dolly	Engr'g 90% complete. Probably 3 (out of 7) completed.
277A AGE Lnch Lock	8 Units. Engr'g 90% complete. Probably 1 fabricated.
289A Baroswitch Stimulator	4 Units. Engr'g 75% complete. No fabrication.
281A Drive A Mech Stops	3 Units. Engr'g 25% complete. No procurement.
280A Star Tracker Fair Stor Ctr	7 Units. 0%.
290A Lnch Lock Force Measuring Device	3 Units. Engr'g 25% complete. No fabrication.
270A Trunnion Load Equalizer	2 Units. Engr'g 90% complete. Probably both in fabrication.
271A In-House Transporter	Engr'g 90% complete. In-house modification probably 50% complete.
273A MAGE Special Tool Kit	3 Units. In preliminary study only.
274A MP Console Test & Ship'g Fixture	4 Units. Engr'g 75% complete. No fabrication.
275A Manual Adapter Platform	2 Units. Engr'g 80% complete. No procurement initiated.
278A Simulated Bulkhead	7 Units. Engr'g 75% complete. No procurement initiated.
279A Trunnion Locks	2 Units. Engr'g 90% complete. One completed, second in fabrication.
283A Inter-Level Work Platforms	Less than 1%. Concept only.

~~SECRET~~/DORIAN

BIF-107-50250-69

Page 37

GE Work Task Status Estimates - 10 June 1969

13.1 CFE's (Continued)

284A Thermal Cover Locks	9 Units. Engr'g 90% complete. Probably 2 units completed.
287A Console Cooling Unit	4 Units. Engr'g 40% complete. No fabrication.
288A Star Trkr Stim Mtg Dev & Sun Sim	3 Units. 0%.
286A GN <sub>2</sub> Supply Sys	90% completed.
293A Comp Position'g Aids	1%. Concept only. 2 Units
294A OH Hdlg Device	1%. Concept only. 2 Units.
295A LM Div Board	1%. Concept only. 2 Units.
296A Crit Comp Prot Covers	1%. Concept only. 2 Units.
297A Thermal Grease Covers	1%. Concept only. 2 Units.
298A Comp Instal'n Adapters	1%. Concept only. 2 Units.
300A Div Board Eqmt Adapter	1%. Concept only. 2 Units.
299A Well Cover	1%. Concept only. 2 Units.
302A Veh 114 Counter Balance	Engr'g 90% complete. In fabrication.
303A Gyro Ctr Wts	1%. Concept only.
Fittings & Shims for MM	
250A Freq Converter	Engr'g 90% complete. One (out of 2) units in fabrication.
332A Dyn (D) Test Set	Delivery due July 1969 (?)
333A Ther (T) Test Set	Delivery due Oct 1969 (?)
384A EMC Test Set	Design approximately 10% completed. No fabrication. 4 Units.

~~SECRET~~/DORIAN

GE Work Task Status Estimates - 10 June 1969

13.2 Test, Adjust, Calibrate, Service, Repair & Maintain AGE for Use  
by GE and at Rochester, HB & VAFB

0% D G

13.3 Provide STE, fixtures, cables, stimulators & simulators for AGE  
Acceptance Testing

STE for MOL CITE 400A/B/C/D - Complete.  
STE for MMTE 400E/F/G - In preliminary design.

13.4 Provide MMFS MDF 104

Status Unknown.

13.5 QC of AGE

Shrader estimates 35%; Egan estimates 15%.

13.6 AGE shall meet 30005 EMC

80% of design completed - not demonstrated.

13.7 AGE Spares

Planning 50% complete; procurement about 25% complete  
(CITE computers).

13.8 Transporter shall be transported in C-5A

Study complete - not demonstrated.

13.9 STE deliverable at end of contract - no 375 requirements

0%

13.10 Ground Alignment

13.10.1 Design Study

Design study about 10% complete.

13.10.2 Ground System to Use FAM Sensors

No GE effort involved.

13.11 IVS Checkout Equipment

13.11.1 Study preliminary design of IVS Checkout Equipment

Rumored to have done something, but no information  
received at Aerospace. Hence, zero work done as far  
as we know.

~~SECRET/DORIAN~~

BIF-107-50250-69  
Page 39

SOW TASK 14.0 SIMULATION AND TRAINING

1. Evaluation of Simulation and Training Effort

Of the overall GE Simulation Task, GE had completed the Stimulus Material Generator (SMG), Elemental Development Simulator (EDS), Mission Development Simulator (MDS) Phase 0, and had completed about 50% of the MDS Phase 3. The Mission Module Simulation Equipment (MMSE) effort had barely begun. An overall completion "score" would be about 50%.

Some elements of this task were behind schedule. For example, EDS was six months late; MDS Phase 0 was seven months late. The GE effort on the MMSE had barely begun.

~~SECRET/DORIAN~~

~~SECRET~~/DORIAN

BIF-107-50250-69  
Page 40

None of the training contracted for had been provided with the exception of one orientation briefing to the MOL crew in late May, 1969.

2. Mission Module Simulation Work Task History

In September, 1966, the following simulation tasks were assigned to GE:

Design, fabricate, operate, maintain and modify, as required, the Stimulus Material Generator (SMG), The Elemental Development Simulator (EDS), the Mission Development Simulator (MDS), and the Mission Module Simulation Equipment (MMSE). The EDS was based upon use of a video acquisition system. It would have one crew station and the scene was generated by a 70 mm motion picture projector. The scene material was to be generated by the SMG which used a moving base camera which filmed a mosaic scene. The EDS used a hybrid computer system consisting of an SDS 930 Digital Computer and a Beckman 2200 Analog Computer. The EDS was to be operational in July, 1967 and was to be used for approximately one year to help verify the mission module design. It was to be followed by the MDS which was originally conceived to be a mere follow-on to the EDS. Another console was to be added, and two other computers were to be added: the IBM 360/44 and the Airborne Digital Computer (ADC). The MMSE would be similar to the MDS, but was only to use the 360/44 and the ADC. It would also have the capability of interfacing with the Douglas supplied Laboratory Module Simulation Equipment (LMSE). A total of 36 months operations time was to be provided on the EDS and MDS. The MMSE was to be operational nine months prior to the first manned flight and would operate through the third manned flight.

Several significant changes in the AVE affected simulation drastically. The largest impact was caused by the change from a video ATS

~~SECRET/DORIAN~~

BIF-107-50250-69  
Page 41

to an optical ATS. This change and technical problems involving use of the motion picture projectors delayed the EDS to the extent that it was not ready to begin operations until January, 1968. The EDS was operated successfully until September, 1968, and did provide valuable data used in AVE design, particularly in controls and displays.

The EDS was unsatisfactory, however, in image quality, suffering from jitter, low resolution and contrast, and small area coverage. For these reasons, a redefinition exercise was held with the Air Force, Aerospace and GE from January to April of 1968 to completely define all simulation requirements. This resulted in a change of the MDS and MMSE to the use of a 9x9 Slide Viewing System (SVS). It also resulted in an attempt at commonality between the MDS and MMSE. The hardware and most of the software for the two simulators would be identical. To achieve this, the hybrid computer was added to the MMSE. In order to expedite schedules for the MDS, GE was permitted to provide only a single station for the first phase of the MDS (Phase 0). Phase 0 was to be operational November 1968. Due to numerous technical problems with the SVS's and with computer software, Phase 0 was not expected to be operational until 1 July 1969. Scene material for the SVS's was being provided by ACIC in St. Louis and the SMG had been converted and was being used for a test bed for the Beta System.

Work on the Mission Module Simulation Equipment had barely begun when the program was cancelled; the largest open area being the software interface with the LMSE.

~~SECRET/DORIAN~~

~~SECRET~~/DORIAN

BIF-107-50250-69  
Page 42

### Simulation Redirection

As a cost and manpower savings, and to solve the recurring computer loading problem, direction was given to GE on approximately 1 June 1969 as follows:

- A. Cancellation of MMSE.
- B. Purchase two 360-65 computers.
- C. Build one simulator called the Mission Module Simulator (MMS) using 106 hardware and the full MMSE software. To be non-CEI.
- D. Attempt to improve quoted operational data of MMS (12/70) by 6 months.

GE as to report by 1 July 1969 on whether the schedule could be improved and whether all software requirements could be met.

### Phase 0 Status

- A. As of 2 June 1969, all test documentation has been agreed upon; thus completing the Test Requirements Document, the Phase 0 Test Plan, and the Phase 0 Test Procedures.
- B. Most Phase 0 software problems have been solved with GE able to run a full Demonstration Orbital Pass (DOP). Some dynamic tests remained to be accomplished and some problems on the DOP were still open, but it appeared that the formal demonstration could be held the first week of July. The following test plan paragraphs remained open: 4.12, 4.15, 4.22, 4.31, 4.43, 4.48, 5.0, and 6.0
- C. Of the completed subsystem tests, the only spec, requirement that GE definitely could not meet was that of ATS exit pupil. A waiver would have been required. The maximum exit pupil site was 2.6 mm x 3.5 mm (spec. 4.0 + .2 mm). Other non-compliant spec. items had been fixed, but not necessarily retested.

~~SECRET~~/DORIAN

~~SECRET~~ DORIAN

BIF-107-50250-69  
Page 43

GE WORK TASK STATUS ESTIMATES

10 June 1969

14.0 Simulation & Training

14.1 MMSE

14.1.1 Design, Fab, C/O, and Deliver MMSE. Deliver Part II Spec.

MMSE hardware design was underway, with completion expected approximately October 1969. A Design Freeze was scheduled for July 1969. The only fabrication on MMSE due date was the structure for the IOS. The SVS's had not been ordered. The software requirements for the MMSE were expected to be completed July 1, 1969.

Design: 20%  
Fabrication: 10%

14.1.2 Provide Q. C.

The only Q. C. provided had been to inspect the IOS console. 5% Completed.

14.1.3 Support, Install, and C/O at VAFB

Vandenberg installation was not scheduled until early 1971. 0%.

14.1.4 Operating Proc.

No work had been done on operating procedures.

14.1.5 Spec. Tools and Test Equipment for Fab. of MMSE

Logic card test equipment had been provided. 5% Completed.

14.1.6 Maintain and Operate EDS for 13 months prior to tear down.

EDS had been operated for 13 months and had been shut down and dismantled in September 1968. 100% Completed.

14.2 Dev. Sim. Equipment

14.2.1 Design, Fab. & C/O MDS

Phase 0 MDS was complete and ready to start operations July 1, 1969. Hardware design for Phase 3 MDS was essentially complete, software design for Phase 3 had only reached the requirements definition stage. Detailed design was scheduled to begin July 1969. 90% of the hardware for MDS Phase 3 had been built and in place. Checkout was about 50% completed.

14.2.2 Operate and Maintain for 42 Operating Months

Of the total 42 operating months, 13 had been used on EDS with 29 months left to be used on MDS. 30 % Completed.

~~SECRET~~ DORIAN

~~SECRET~~ DORIAN

BIF-107-50250-69  
Page 44

GE Work Task Status Estimates - 10 June 1969

14.2.3 Modify EDS

EDS block change had been completed during EDS operations. 100% Complete.

14.2.4 Modify MDS H/W & S/W

A few minor panel changes had been made to MDS prior to operation. 10% Complete.

14.2.5 Provide Anomorphic Lens Module

An extra anomorphic lens module without the anomorphic glass had been provided in May 1969. 100% Complete.

14.2.6 SVS Bench Measurements

GE had submitted an SVS bench plan which had not yet been implemented. 0% Complete.

14.3 MMSE Operations

14.3.1 VAFB Ops, Engr. Support, Utiliz. Planning, Simulation  
14.3.2 Preparation, Operating Shifts, Instructors/Console  
Operators, Maintenance and Post-Simul. Activities

GE had provided some long range planning inputs for VAFB operations. 10% Complete.

14.3.3 Support of VAFB MMSE Ops. & Maintenance

No Vandenberg operations had been accomplished. 0% Complete.

14.3.4 MMSE Spares

No MMSE Spaces had been provided.

14.4 Training Activities

GE had not provided any training. 0% Complete.

14.5 Post Pass TLM Simulation

GE had supported Douglas in some essential Post Pass TLM studies.  
10% Complete.

~~SECRET~~ DORIAN

~~SECRET/DORIAN~~

BIF-107-50250-69

Page 45

SOW TASK 15.0 SYSTEM TEST

1. Evaluation of System Test Tasks

The GE effort of system test was proceeding on schedule for the in-house test program. However, the test requirements definition and test planning for this activity was poor and, for DSS-1, the Systems Office reviewed test plans for approval after the tests were completed.

Test planning and requirements definition for system level integrated testing at EK and MDAC-WD was behind schedule.

A. Planning Status

Top level planning was completed to the 1968 baseline in the Contractual Ground Test Plan. Revision to conform to the 1969 baseline was not started at the time of program cancellation.

The DSS-1 Development Test Plan was submitted in May, 1969; Aerospace critique transmitted to the Air Force on 6 June 1969 for incorporation in final issue which was scheduled for publication in August, 1969. Scope of this document covered subsystem development, but did not include higher levels of integration. 70% Complete.

The Vehicle 113D Detailed Test Plan in the form of the GE "Pre-Test Report" received and approved. 100% Complete.

The Vehicle 113T Detailed Test Plan in the form of the "Pre-Test Report" received and under review at termination. 90% Complete.

Integrated testing covered by interface specifications for eastern testing were completed in draft to the test objectives and time-line level of detail (10%). Initial efforts had started for definition of western testing, through the LVITRS (Lab Vehicle Integrated Test Requirements Specification) (<5%).

~~SECRET/DORIAN~~

~~SECRET/DORIAN~~

BIF-107-50250-69  
Page 46

B. Testing Status

DSS-1 testing was on schedule. DSS-1 subsystem testing for telemetry and command was completed and integration of the two were in process. Facility requirements for testing of Navigation and Control components were complete.

As of 10 June 1969, GE had accomplished approximately 60 per cent of the planned structural testing (113D) at GE, Valley Forge. Test phases completed include static and shock testing for the third load cycle. Additionally, both pre- and post-alignment checks and evaluations for static and shock testing have been performed. Vibration testing was scheduled to begin in late June, 1969.

As of 10 June 1969, GE Thermal Test Program (113T) at Valley Forge had not been initiated. The basic hardware, consisting of the MMFS, MMAS Test Assembly and LMTS, were received by GE in early 1969. These items which make up the basic test specimen configuration were placed in a thermal chamber for RTV bakeout. The LMTS exterior paint coating experienced severe cracking and peeling and was returned to DAC for a new exterior skin.

~~SECRET/DORIAN~~

BIF-107-50250-69

Page 47

GE WORK TASK STATUS ESTIMATES

10 June 1969

15.0 SYSTEM TEST

15.2 System Development & Qualification at Valley Forge

15.2.1 Furnish Test Articles

- a. 102 Mockup - Completed
- b. 102L Console Mockup - Completed
- c. 103 Metal Mockup - Completed
- d. 103L Console Mockup and Mods for (A)  
80% completed - No (A) mods
- e. 114 Systems Development Vehicle  
Some component procurement only
- f. 115 Qualification Vehicle  
Some component procurement only
- g. DSS-1 Development Subsystem  
Fabrication 50% completed
- h. 113T  
Vehicle in final assembly
- i. 113D  
Fabrication completed.

15.2.2 Conduct MMSS System Development and Qualification Tests,  
Evaluate and Take Corrective Action

- a. DSS-1 - 30%
- b. 113D - 80%
- c. 114 - 0%
- d. 115 - 0%

15.2.3 Conduct LMQTV Compatibility Tests at KOP (GD-6/EG-29)

0%

15.3 Supply Test Articles, Simulators and Interface Units:

- (GD-2) LM/MP Equipment - MDF  
Delivered
- (GD-5) DSS-1 for EDCTU  
Not Delivered
- (GD-38) LM/MP Inertial Sub  
Design Complete - Not Delivered
- (GE-82) LM Bulk Insul. Blanket  
Designed - Not Delivered
- (GD-40) Wire Harness for GD-2  
Designed - Not Delivered
- (GE-2) MMFS (113T)  
0% Refurbishment Not Accomplished
- (GE-18) LM Thermal Sub  
0% - Refurbishment Not Accomplished

~~SECRET/DORIAN~~

~~SECRET/DORIAN~~

GE Work Task Status Estimates - 10 June 1969

- (GE-31) MMFS (115)  
0% - Refurbishment Not Accomplished
- (GE-33) MMFS (113D)  
0% - Refurbishment Not Accomplished
- (GE-4) MMFS (114E)  
Designed - Partial Component Procurement
- (GE-49A) MMFS Structural Assembly  
(GE-49B)  
Designed - Partial Component Procurement
- (GE-48A, LM Support Structure (Bays 2 \* 8)  
B, & C)  
Delivered Two of Three
- (GD-9A, MM T/V Subst.  
B & C)  
Designed - Partial Component Procurement
- (GD-34) LM/MP T/V Subs  
Designed - Probably no Fab Work
- (GE-50) MM Door Handling Equipment  
Designed - Not Delivered

- 15.4 Starting 1/1/69 Provide Test Ops & Supported at H. B  
0%
- 15.4.1 Define GE Facility Requirements  
75%
- 15.4.2 Integrate EK Facility Requirements  
50%
- 15.5 Starting 1/1/69 Provide Test Ops and Support at  
Rochester  
0%
- 15.5.1 Define Facility Requirements  
50%
- 15.6 Provide Administrative Services at H. B. & Rochester  
Essentially 0% since effort on 15.4 and 15.5  
has not started
- 15.7 Up to 31 December 1968 Plan and Define Test and  
Facility Requirements at H. B. & Rochester  
Completed
- 15.8 Upon Written Air Force Authority to Proceed, Support  
Neutral Buoyancy Testing  
0%

~~SECRET/DORIAN~~

BIF-107-50250-69

Page 49

SOW TASK 16.0 LAUNCH OPERATIONS AND SERVICES

This effort, to date, under this SOW task, was limited to in-house planning and support of Air Force planning. In general, the planning effort was on schedule, but still in process.

16.1 Plan and Define MMSS Launch Operation Through December 1968

All of this effort has been completed. Documents submitted reflecting the completed effort are the Program Requirements Document inputs, the Activation Guide, and the Checkout Requirements Plan. Additional effort was provided to working groups.

16.2 Starting 1 January 1969, Provide Launch Operation Planning, Activation, C/O, Launch, Recycle and Turn-Around

Only planning effort was provided under this paragraph. This was reflected in an updated Checkout Requirements Plan, and Activation Manual for SLC-6, and an Activation Manual for 8310. A preliminary Activation Manual for the MOL Support Facilities was also issued. Additional effort was provided in support of the Launch Operations Flow Subgroup. Effort has not been provided for integrated LV testing at VAFB (LVITRS) and integrated test procedures.

~~SECRET~~/DORIAN

BIF-107-50250-69  
Page 50

GE WORK TASK STATUS ESTIMATES

10 June 1969

- 16.0      LAUNCH OPERATIONS
- 16.1      Through 31 December 1968, Plan and Define MMSS Launch Operations - Completed 100%.
- 16.2      Starting 1 January 1969, Provide Launch Operations and Support Services for Planning, Activation, C/O, Launch, Recycle and Turn-Around - Planning - 10%.
  - Systems Effectiveness/Launch Operations - 0%.
- 16.2.1    In Support of 116, 118, 119 and 120 - 0%.
- 16.2.2    Integrate EK Facility Requirements - 0%.
- 16.2.3    Provide Administrative Services - 0%.

~~SECRET~~/DORIAN

~~SECRET~~/DORIAN

BIF-107-50250-69  
Page 51

SOW TASK 17.0 FLIGHT OPERATIONS AND SERVICES

This task covers the effort required to plan and support flight operations, computer program development and computer program modifications and support for Category II and III testing.

A. Flight Operations Planning

The planning work to define flight operation and services at Sunnyvale were on schedule; 17.8 - 100% and 17.1.1 - 5%. The required documentation inputs (17.2) were also on schedule. Other activities in operation planning had not been initiated to our knowledge.

B. Computer Program Development (17.9)

The onboard software, AGE software and simulation software are also discussed in 11.0, 13.0 and 14.0 respectively. The activity covered by this task is the actual coding and preparation of the programs. The work is estimated to be approximately 40 percent complete.

C. Computer Program Modification and Support(17.10)

No effort has been expended against this task to our knowledge.

~~SECRET~~/DORIAN

GE WORK TASK STATUS ESTIMATES

10 June 1969

- 17.0 FLIGHT OPERATIONS AND SERVICES
- 17.1 MMSS Operations Integration
- 17.1.1 Flight Operations Planning and Support Working Group Meetings.  
5%
- 17.2 Operational Doc - Provide Inputs per the STOP, 20020/30020  
10%
- 17.3 Certification of Flight Ops Support Personnel  
0%
- 17.4 Plan and Support Flight Rehearsals including with Mission Simulator  
0%
- 17.5 Support Flight Operations
  - a. Identify data and data reduction required - 0%
  - b. Perform data analysis - 0%
  - c. Analyze trend data - 0%
  - d. Coordinate IF problem areas - 0%
  - e. Work on problem solving teams - 0%
  - f. Report results of analysis - 0%
  - g. Provide command requirements - 0%
  - h. Prepare quick look reports - 0%
  - i. Provide inputs to POAD - 0%
- 17.6 Provide Commanding Requirements in Support of Mission Simulator  
0%
- 17.7 Plan and Activate GE Sunnyvale Facility  
0%
- 17.8 Through 31 December 1968 Define Flight Operations and Services at Sunnyvale  
100%

GE Work Task Status Estimates - 10 June 1969

17.9 Computer Program Development - Develop and Deliver:

- a. CITE - DORP (801A)  
Design and coding 40% complete
- b. On Board Program (802A)  
Overall effort approximately 55% complete  
not including program maintenance
- c. Command and Control (804A)  
0%
- d. Command and Control (804I)  
Total effort estimated to be 40% complete
- e. AGE Test Support (805A)  
Design 90% completed; coding 80% completed;  
Testing 20% completed
- f. MMSE C.P. (807A)  
Total effort estimated to be 41% completed
- g. MMTE C.P. (809A)  
0% (See 11.2.1f)
- h. MMTE - DORP (801E)  
Preliminary planning only

17.10 C.P. Modification and Support (for Cat II & III Testing)

- a. 801A  
0%
- b. 802A  
0%
- c. 804A/AI  
0%
- d. 805A  
0%
- e. 807A  
0%
- f. 809A  
0%
- g. MOLTOL Compiler  
0%
- h. 801E  
0%

~~SECRET~~/DORIAN

BIF-107-50250-69

Page 54

GE Work Task Status Estimates - 10 June 1969

17.10.1 Operational Support

- a. Diagnosis and trouble shooting - 0%
- b. Maintain library cords, decks, tapes  
and documentation. - 0%

17.10.2 Program Modification

Implement, test and install charges per  
20012 for above listed CP CEI's. - 0%

17.11 Perform as CPIC for Orbital Flight Support Systems  
Module

Effort prorated over life of contract.

~~SECRET/DORIAN~~

BIF-107-50250-69  
Page 55

SOW TASK 18.0 DOCUMENTATION

Aerospace Corporation comments on CDRL submittals, where appropriate, have been individually transmitted to the Air Force and no additional comments are provided herein. Where appropriate to the technical evaluation, comments on selected documents are included in earlier sections of this report.

~~SECRET/DORIAN~~

BIF-107-50250-69  
Page 56

SOW TASK 19.0 MANAGEMENT

Evaluation of this task is limited to Task 19.1.4, EMC Control Plan, and 19.3, System Effectiveness Management.

The preparation of plans for the two tasks are complete. The plans have all been submitted and approved. Management of the implementation of this plan was not evaluated.

List of Plans

19.1.4	EMC Control Plan per 30035/24005
19.3	Reliability Plan
	System Safety Engineering Plan
	Quality Assurance Plan
	Effectiveness Assessment Plan
	Human Engineering Plan
	Maintainability Plan